AMENDMENT TO THE CLAIMS

Please **AMEND** claim 4 as follows.

A copy of all pending claims and a status of the claims are provided below.

1. (original) A wheel speed calculation method wherein, to calculate wheel speed at the calculation timing of a given period based on a pulse signal provided by shaping the waveform of a detection signal of a wheel speed sensor, the wheel speed sensor including a rotor with a plurality of detected elements rotating with wheel which is a controlled object,

when both rising and falling edges occur in the present calculation period, wheel speed VW is calculated as follows:

$$VW = [K \times \{Nu(n) + Nd(n)\}] / \{\Delta Tu(n) + \Delta Td(n)\}$$

when a rising edge does not occur although a falling edge occurs in the present calculation period, the value of VW1 or VW2, whichever is the lower, is selected as the wheel speed VW, VW1 and VW2 being calculated as follows:

$$VW1 = [K \times \{Nu(n-1) + Nd(n)\}] / \{\Delta Tu(n-1) + \Delta Td(n)\}$$

$$VW2 = [K \times \{1 + Nd(n)\}] / \{\Delta Tut + \Delta Td(n)\}$$

when a falling edge does not occur although a rising edge occurs in the present calculation period, the value of VW3 or VW4, whichever is the lower, is selected as the wheel speed VW, VW3 and VW4 being calculated as follows:

$$VW3 = [K \times \{Nu(n) + Nd(n-1)\}] / \{\Delta Tu(n) + \Delta Td(n-1)\}$$

$$VW4 = [K \times \{Nu(n) + 1\}] / \{\Delta Tu(n) + \Delta Tdt\}$$

when neither a rising edge nor a falling edge occurs in the present calculation period, a comparison is made between the minimum value of VW5 to VW7 and the preceding wheel speed VW and the minimum value or the preceding wheel speed VW, whichever is the lower, is selected as the present wheel speed VW, VW5 to VW7 being calculated as follows:

$$VW5 = [K \times \{1 + Nd(n-1)\}] / \{\Delta Tut + \Delta Td(n-1)\}$$

$$VW6 = [K \times \{Nu(n-1)+1\}]/\{\Delta Tu(n-1) + \Delta Tdt\}$$

$$VW7 = (K \times 2)/(\Delta Tut + \Delta Tdt)$$

wherein ΔTu(n) is the rising side speed calculation reference time between the instant at which the last rising edge of the pulse signal in the preceding calculation period occurs and the instant at which the last rising edge in the present calculation period occurs,

ΔTd(n) is the falling side speed calculation reference time between the instant at which the last falling edge of the pulse signal in the preceding calculation period occurs and the instant at which the last falling edge in the present calculation period occurs,

Nu(n) is the number of occurrences of the rising edge within the rising side speed calculation reference time ΔTu(n),

Nd(n) is the number of occurrences of the falling edge within the falling side speed calculation reference time ΔTd(n),

ΔTut is the rising side speed calculation temporary reference time between the instant at which the last rising edge occurs and the present calculation timing when no rising edge occurs in the present calculation period,

ΔTdt is the falling side speed calculation temporary reference time between the instant at which the last falling edge occurs and the present calculation timing when no falling edge occurs in the present calculation period,

K is a constant determined in response to a tire to which calculation of the wheel speed is applied and the number of detected elements of a rotor of the wheel speed sensor and

ΔTu(n-1), ΔTd(n-1), Nu(n-1), and Nd(n-1) are the value of the rising side speed calculation reference time ΔTu(n), the value of the falling side speed calculation reference time ΔTd(n), the value of the number of occurrences Nu(n), and the value of the number of occurrences Nd(n) in the preceding calculation period respectively.

2. (original) A wheel speed calculation method as set forth in claim 1 calculates the wheel speed used for brake control.

3. (original) A wheel speed calculation method as set forth in claim 2, the wheel speed VW is calculated in a control unit for the brake.

4. (currently amended) A wheel speed calculation method wherein, to calculate wheel speed at the calculation timing of a given period based on a pulse signal provided by shaping the waveform of a detection signal of a wheel speed sensor, the wheel speed sensor including a rotor with a plurality of detected elements rotating with wheel which is a controlled object; the method comprising: calculating wheel speed VW with expressions, ~~wherein different expressions,~~ wherein different expressions are applied respectively when both rising and falling edges of the pulse signal occur in the present calculation period,

when the rising edge does not occur although the falling edge occurs in the present calculation period,

when the falling edge does not occur although the rising edge occurs in the present calculation period,

when neither the rising edge nor the falling edge occurs in the present calculation period.

5. (previously presented) A wheel speed calculation method as claimed in claim 4, wherein,

when both rising and falling edges occur in the present calculation period, wheel speed VW is calculated as follows:

$$VW = [K \times \{Nu(n) + Nd(n)\}] / \{\Delta Tu(n) + \Delta Td(n)\}$$

when a rising edge does not occur although a falling edge occurs in the present calculation period, the value of VW1 or VW2, whichever is the lower, is selected as the wheel speed VW, VW1 and VW2 being calculated as follows:

$$VW1 = [K \times \{Nu(n-1) + Nd(n)\}] / \{\Delta Tu(n-1) + \Delta Td(n)\}$$

$$VW2 = [K \times \{1 + Nd(n)\}] / \{\Delta Tut + \Delta Td(n)\}$$

when a falling edge does not occur although a rising edge occurs in the present calculation period, the value of VW3 or VW4, whichever is the lower, is selected as the wheel speed VW, VW3 and VW4 being calculated as follows:

$$VW3 = [K \times \{Nu(n) + Nd(n-1)\}]/\{\Delta Tu(n) + \Delta Td(n-1)\}$$

$$VW4 = [K \times \{Nu(n) + 1\}]/\{\Delta Tu(n) + \Delta Tdt\}$$

when neither a rising edge nor a falling edge occurs in the present calculation period, a comparison is made between the minimum value of VW5 to VW7 and the preceding wheel speed VW and the minimum value or the preceding wheel speed VW, whichever is the lower, is selected as the present wheel speed VW, VW5 to VW7 being calculated as follows:

$$VW5 = [K \times \{1 + Nd(n-1)\}]/\{\Delta Tut + \Delta Td(n-1)\}$$

$$VW6 = [K \times \{Nu(n-1) + 1\}]/\{\Delta Tu(n-1) + \Delta Tdt\}$$

$$VW7 = (K \times 2)/(\Delta Tut + \Delta Tdt)$$

wherein ΔTu(n) is the rising side speed calculation reference time between the instant at which the last rising edge of the pulse signal in the preceding calculation period occurs and the instant at which the last rising edge in the present calculation period occurs,

ΔTd(n) is the falling side speed calculation reference time between the instant at which the last falling edge of the pulse signal in the preceding calculation period occurs and the instant at which the last falling edge in the present calculation period occurs,

Nu(n) is the number of occurrences of the rising edge within the rising side speed calculation reference time ΔTu(n),

Nd(n) is the number of occurrences of the falling edge within the falling side speed calculation reference time ΔTd(n),

ΔTut is the rising side speed calculation temporary reference time between the instant at which the last rising edge occurs and the present calculation timing when no rising edge occurs in the present calculation period,

ΔTdt is the falling side speed calculation temporary reference time between the instant at which the last falling edge occurs and the present calculation timing when no falling edge occurs in the present calculation period,

K is a constant determined in response to a tire to which calculation of the wheel speed is applied and the number of detected elements of a rotor of the wheel speed sensor, and

$\Delta Tu(n-1)$, $\Delta Td(n-1)$, $Nu(n-1)$, and $Nd(n-1)$ are the value of the rising side speed calculation reference time $\Delta Tu(n)$, the value of the falling side speed calculation reference time $\Delta Td(n)$, the value of the number of occurrences $Nu(n)$, and the value of the number of occurrences $Nd(n)$ in the preceding calculation period respectively.

6. (previously presented) A wheel speed calculation method as set forth in claim 5, which calculates the wheel speed used for brake control.

7. (previously presented) A wheel speed calculation method as set forth in claim 6, in which the wheel speed VW is calculated in a control unit for the brake.

8. (previously presented) A wheel speed calculation apparatus comprising:

a control unit that receives a pulse signal provided by shaping a waveform of a detection signal of a wheel speed sensor;

wherein the control unit calculates wheel speed VW with expressions that are respectively different when both rising and falling edges of the pulse signal occur in a present calculation period, when the rising edge does not occur although the falling edge occurs in the present calculation period, when the falling edge does not occur although the rising edge occurs in the present calculation period, and when neither the rising edge nor the falling edge occurs in the present calculation period.

9. (previously presented) A vehicle brake control apparatus, as claimed in claim 8, further comprising:

a wheel speed sensor that outputs a detection signal; and

a waveform shaping circuit for shaping a waveform of the detection signal; wherein the control unit calculates a wheel speed at a calculation timing of a given period based on the pulse signal; and the apparatus further comprises

a brake actuator controlled by a control unit in response to the calculated wheel speed.

10. (previously presented) A wheel speed calculation method apparatus as claimed in claim 8 wherein, when both rising and falling edges occur in the present calculation period, wheel speed VW is calculated as follows:

$$VW = [K \times \{Nu(n) + Nd(n)\}] / \{\Delta Tu(n) + \Delta Td(n)\}$$

when a rising edge does not occur although a falling edge occurs in the present calculation period, the value of VW1 or VW2, whichever is the lower, is selected as the wheel speed VW, VW1 and VW2 being calculated as follows:

$$VW1 = [K \times \{Nu(n-1) + Nd(n)\}] / \{\Delta Tu(n-1) + \Delta Td(n)\}$$

$$VW2 = [K \times \{1 + Nd(n)\}] / \{\Delta Tut + \Delta Td(n)\}$$

when a falling edge does not occur although a rising edge occurs in the present calculation period, the value of VW3 or VW4, whichever is the lower, is selected as the wheel speed VW, VW3 and VW4 being calculated as follows:

$$VW3 = [K \times \{Nu(n) + Nd(n-1)\}] / \{\Delta Tu(n) + \Delta Td(n-1)\}$$

$$VW4 = [K \times \{Nu(n) + 1\}] / \{\Delta Tu(n) + \Delta Tdt\}$$

when neither a rising edge nor a falling edge occurs in the present calculation period, a comparison is made between the minimum value of VW5 to VW7 and the preceding wheel speed VW and the minimum value or the preceding wheel speed VW, whichever is the lower, is selected as the present wheel speed VW, VW5 to VW7 being calculated as follows:

$$VW5 = [K \times \{1 + Nd(n-1)\}] / \{\Delta Tut + \Delta Td(n-1)\}$$

$$VW6 = [K \times \{Nu(n-1) + 1\}] / \{\Delta Tu(n-1) + \Delta Tdt\}$$

$$VW7 = (K \times 2) / (\Delta Tut + \Delta Tdt)$$

wherein ΔTu(n) is the rising side speed calculation reference time between the instant at which the last rising edge of the pulse signal in the preceding calculation period occurs and the instant at which the last rising edge in the present calculation period occurs,

$\Delta Td(n)$ is the falling side speed calculation reference time between the instant at which the last falling edge of the pulse signal in the preceding calculation period occurs and the instant at which the last falling edge in the present calculation period occurs,

$Nu(n)$ is the number of occurrences of the rising edge within the rising side speed calculation reference time $\Delta Tu(n)$,

$Nd(n)$ is the number of occurrences of the falling edge within the falling side speed calculation reference time $\Delta Td(n)$,

ΔTut is the rising side speed calculation temporary reference time between the instant at which the last rising edge occurs and the present calculation timing when no rising edge occurs in the present calculation period,

ΔTdt is the falling side speed calculation temporary reference time between the instant at which the last falling edge occurs and the present calculation timing when no falling edge occurs in the present calculation period,

K is a constant determined in response to a tire to which calculation of the wheel speed is applied and the number of detected elements of a rotor of the wheel speed sensor and

$\Delta Tu(n-1)$, $\Delta Td(n-1)$, $Nu(n-1)$, and $Nd(n-1)$ are the value of the rising side speed calculation reference time $\Delta Tu(n)$, the value of the falling side speed calculation reference time $\Delta Td(n)$, the value of the number of occurrences $Nu(n)$, and the value of the number of occurrences $Nd(n)$ in the preceding calculation period respectively.

11. (previously presented) A wheel speed calculation method as set forth in claim 10, which calculates the wheel speed used for brake control.

12. (previously presented) A wheel speed calculation method as set forth in claim 11, in which the wheel speed VW is calculated in a control unit for the brake.

13. (previously presented) A wheel speed calculation method apparatus as claimed in claim 6 wherein,

when both rising and falling edges occur in the present calculation period, wheel speed VW is calculated as follows:

$$VW = [K \times \{Nu(n) + Nd(n)\}] / \{\Delta Tu(n) + \Delta Td(n)\}$$

when a rising edge does not occur although a falling edge occurs in the present calculation period, the value of VW1 or VW2, whichever is the lower, is selected as the wheel speed VW, VW1 and VW2 being calculated as follows:

$$VW1 = [K \times \{Nu(n-1) + Nd(n)\}] / \{\Delta Tu(n-1) + \Delta Td(n)\}$$

$$VW2 = [K \times \{1 + Nd(n)\}] / \{\Delta Tut + \Delta Td(n)\}$$

when a falling edge does not occur although a rising edge occurs in the present calculation period, the value of VW3 or VW4, whichever is the lower, is selected as the wheel speed VW, VW3 and VW4 being calculated as follows:

$$VW3 = [K \times \{Nu(n) + Nd(n-1)\}] / \{\Delta Tu(n) + \Delta Td(n-1)\}$$

$$VW4 = [K \times \{Nu(n) + 1\}] / \{\Delta Tu(n) + \Delta Tdt\}$$

when neither a rising edge nor a falling edge occurs in the present calculation period, a comparison is made between the minimum value of VW5 to VW7 and the preceding wheel speed VW and the minimum value or the preceding wheel speed VW, whichever is the lower, is selected as the present wheel speed VW, VW5 to VW7 being calculated as follows:

$$VW5 = [K \times \{1 + Nd(n-1)\}] / \{\Delta Tut + \Delta Td(n-1)\}$$

$$VW6 = [K \times \{Nu(n-1) + 1\}] / \{\Delta Tu(n-1) + \Delta Tdt\}$$

$$VW7 = (K \times 2) / (\Delta Tut + \Delta Tdt)$$

wherein ΔTu(n) is the rising side speed calculation reference time between the instant at which the last rising edge of the pulse signal in the preceding calculation period occurs and the instant at which the last rising edge in the present calculation period occurs,

ΔTd(n) is the falling side speed calculation reference time between the instant at which the last falling edge of the pulse signal in the preceding calculation period occurs and the instant at which the last falling edge in the present calculation period occurs,

Nu(n) is the number of occurrences of the rising edge within the rising side speed calculation reference time ΔTu(n),

Nd(n) is the number of occurrences of the falling edge within the falling side speed calculation reference time $\Delta Td(n)$,

ΔTut is the rising side speed calculation temporary reference time between the instant at which the last rising edge occurs and the present calculation timing when no rising edge occurs in the present calculation period,

ΔTdt is the falling side speed calculation temporary reference time between the instant at which the last falling edge occurs and the present calculation timing when no falling edge occurs in the present calculation period,

K is a constant determined in response to a tire to which calculation of the wheel speed is applied and the number of detected elements of a rotor of the wheel speed sensor and

$\Delta Tu(n-1)$, $\Delta Td(n-1)$, Nu(n-1), and Nd(n-1) are the value of the rising side speed calculation reference time $\Delta Tu(n)$, the value of the falling side speed calculation reference time $\Delta Td(n)$, the value of the number of occurrences Nu(n), and the value of the number of occurrences Nd(n) in the preceding calculation period respectively.

14. (previously presented) A wheel speed calculation method as set forth in claim 13, which calculates the wheel speed used for brake control.

15. (previously presented) A wheel speed calculation method as set forth in claim 14, in which the wheel speed VW is calculated in a control unit for the brake.